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Effect of electric field distribution on the morphologies of laser-induced damage in hafnia-silica multilayer polarizers*

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Hafnia-silica multilayer polarizers were deposited by e-beam evaporation onto BK7 glass substrates. The polarizers were designed to operate at a wavelength of 1064 nm at Brewster's angle (56°). The polarizers were tested with a 3-ns laser pulse at 45°, 56°, and 65° incidence angle in order to vary the electric field distribution in the multilayer, study their effects on the damage morphology, and investigate the possible advantages of off-use angle laser conditioning. The morphology of the laser-induced damage was characterized by optical and scanning electron microscopy. Four distinct damage morphologies (pit, flat bottom pit, scald, and outer layer delamination) were observed. These damage morphologies were found to depend strongly on the angle of incidence of the laser beam. In particular, massive delamination observed at 45° and 56° incidence, did not occur at 65°. Instead, large and deep pits were found at 65°. The electric field distribution in the multilayer was calculated to attempt to better understand the relationship between damage morphology, electric field peak locations, and maximum thermal stress gradients.

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